CGWAVE: A COASTAL WAVE PREDICTION MODEL

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BACKGROUND

Elliptic CRD Equation:

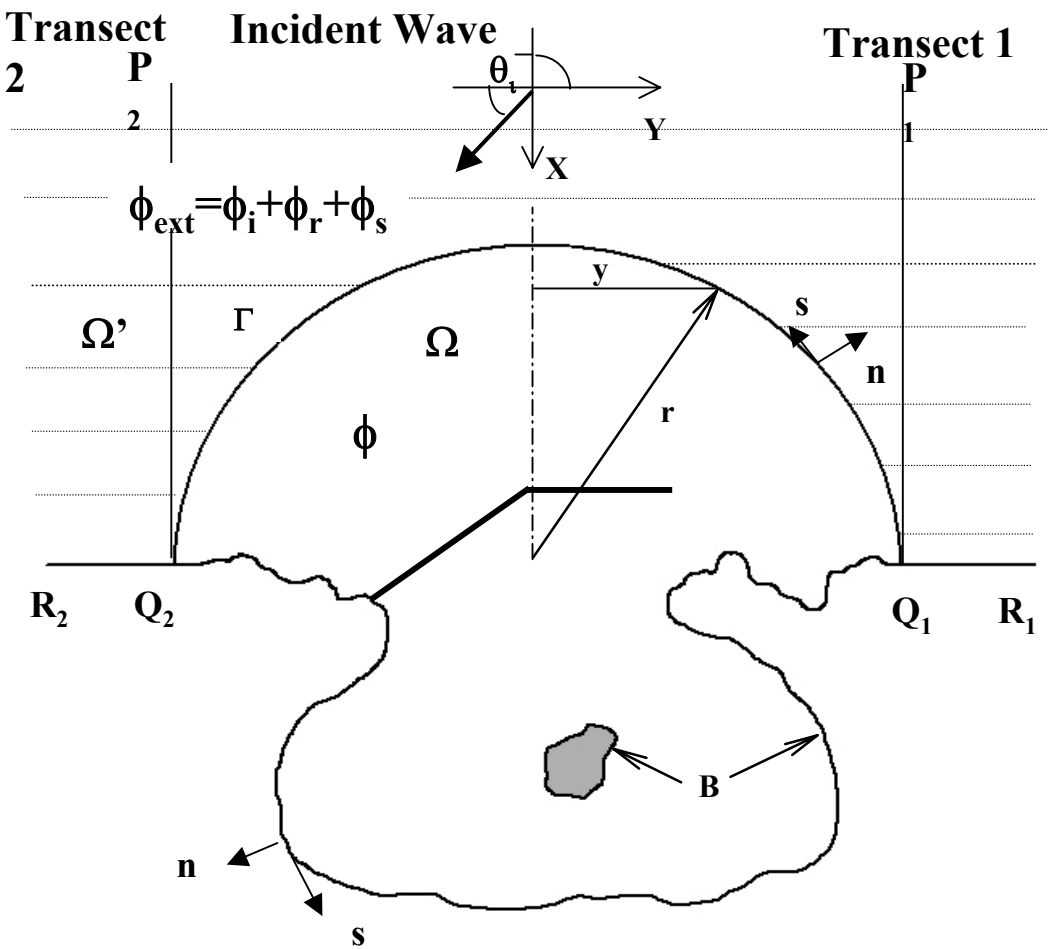
$$\nabla.(CC_g\nabla\phi) + \{k^2CC_g + i\sigma w + iC_g\sigma\gamma + F_1(kd)\nabla^2 h + F_2(kd)(\nabla h)^2\}\phi = 0$$

- Diffraction
- Reflection
- Refraction
- Breaking
- Bottom Friction
- Entrance Losses
- Wave-current Interaction
- Wave-wave Interaction
- No Wind Input

Model Features

- Arbitrary domains and structures with linear triangular finite elements
- Wavelength-dependent grid resolution in SMS
- A large system of discretized equations solved with iterative and direct solvers
- Convergence guaranteed
- Ideal for inlets, ports and harbors
- Wave-current and wave-wave interaction in development

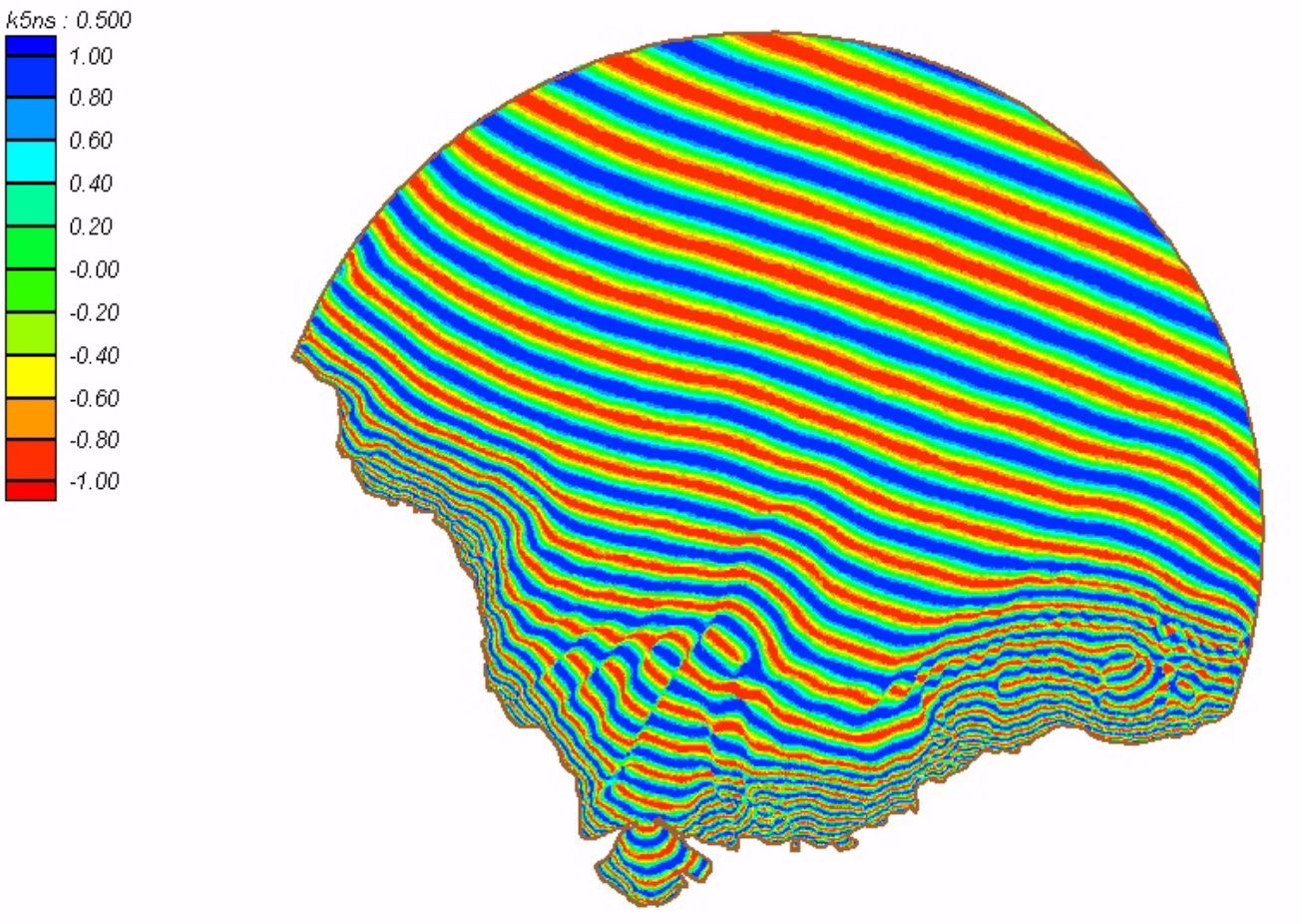
CGWAVE Model Layout



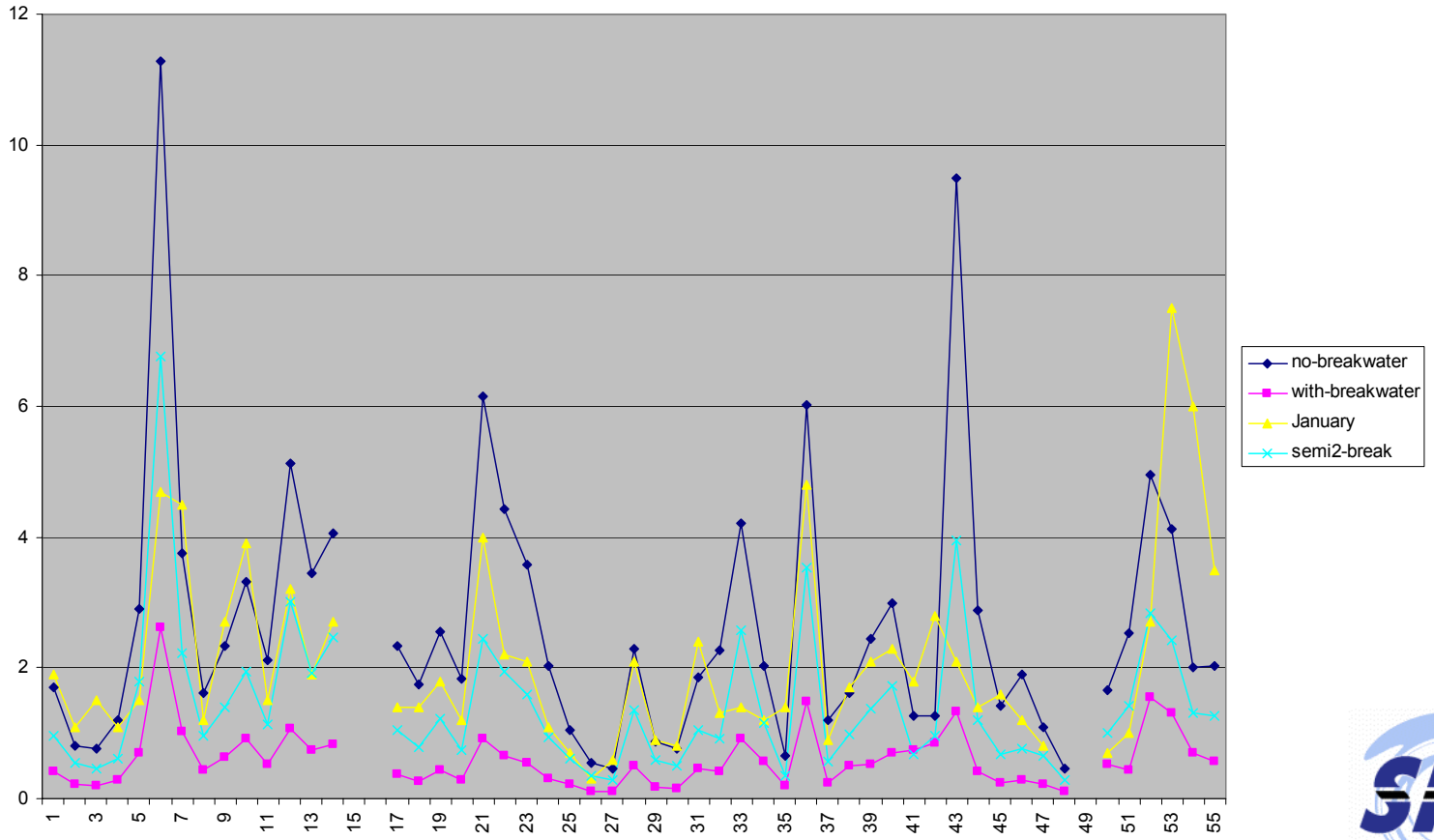
$$\alpha = ik\frac{1-K_r}{1+K_r}$$

$$\frac{\partial\phi}{\partial n} = \alpha\phi$$

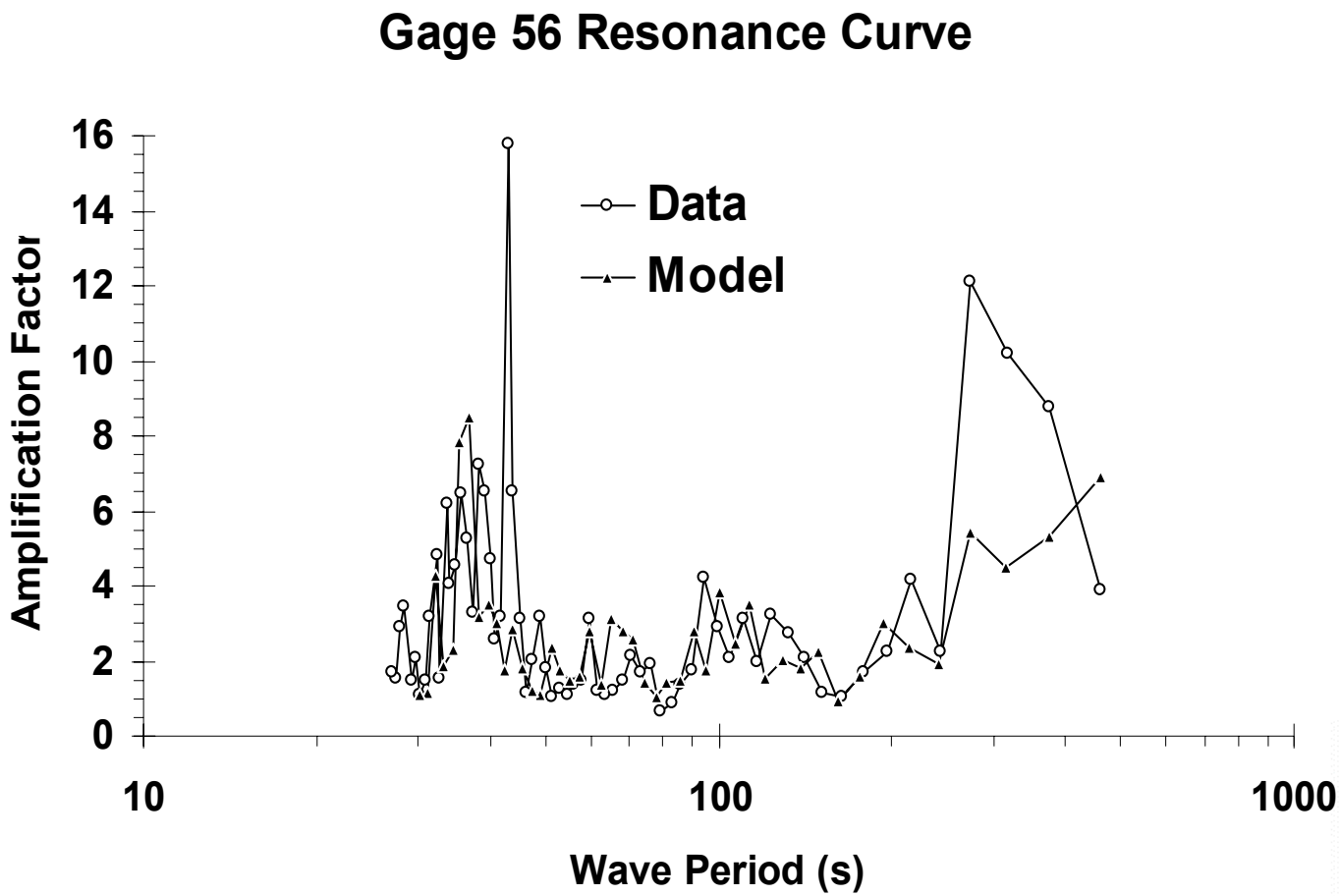
Kahului Harbor, HI



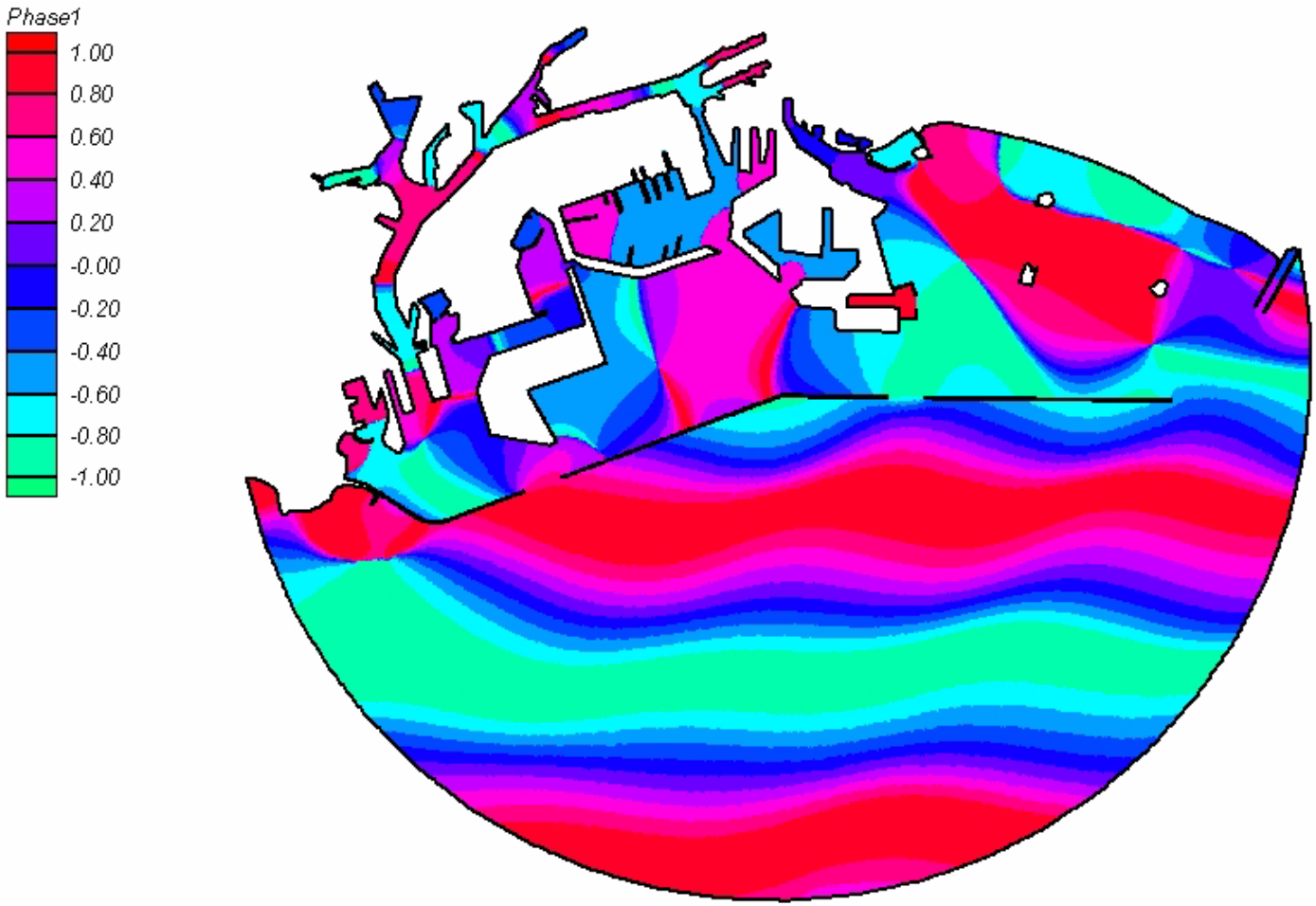
LALB – Model and Lab Measurements



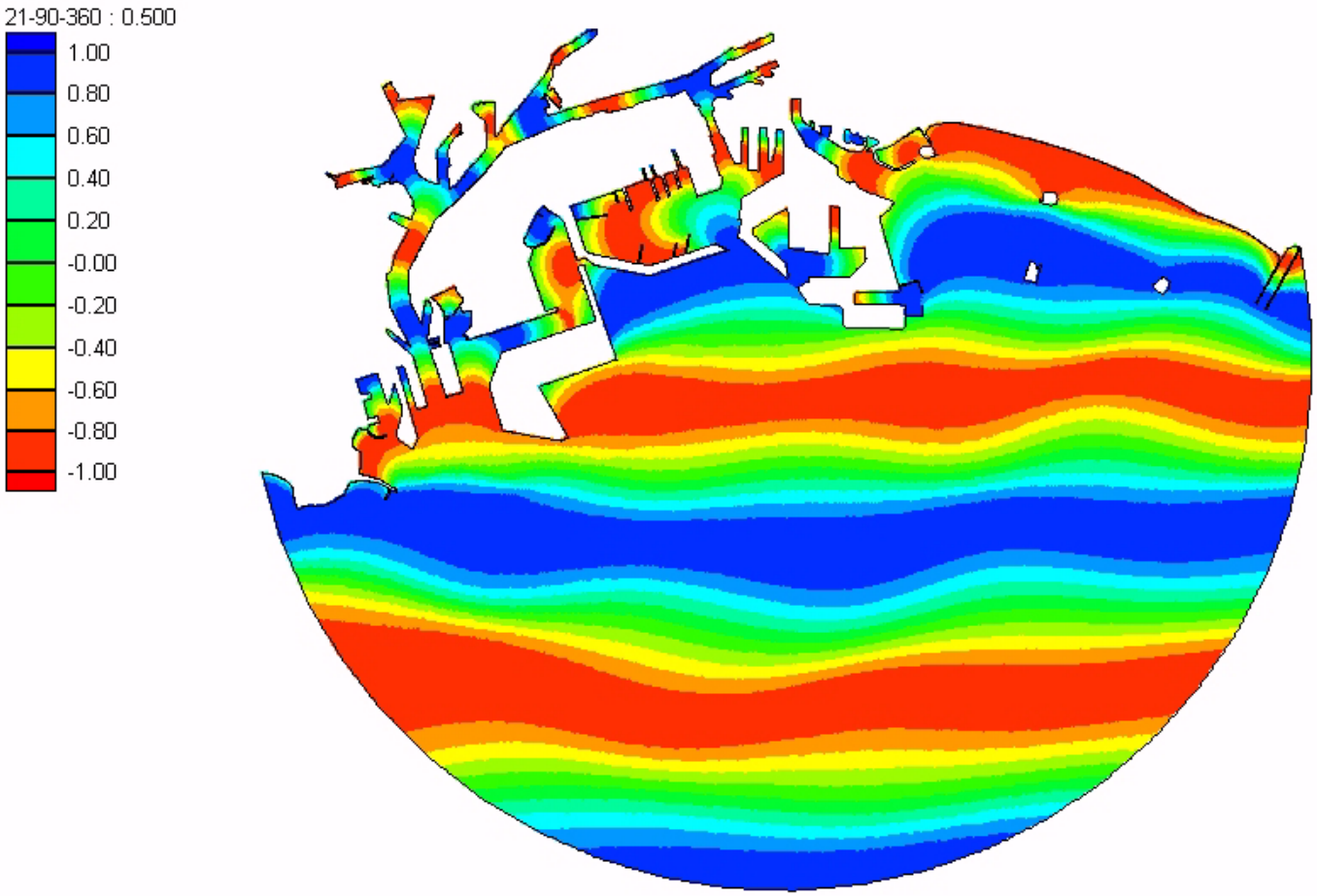
LALB Complex



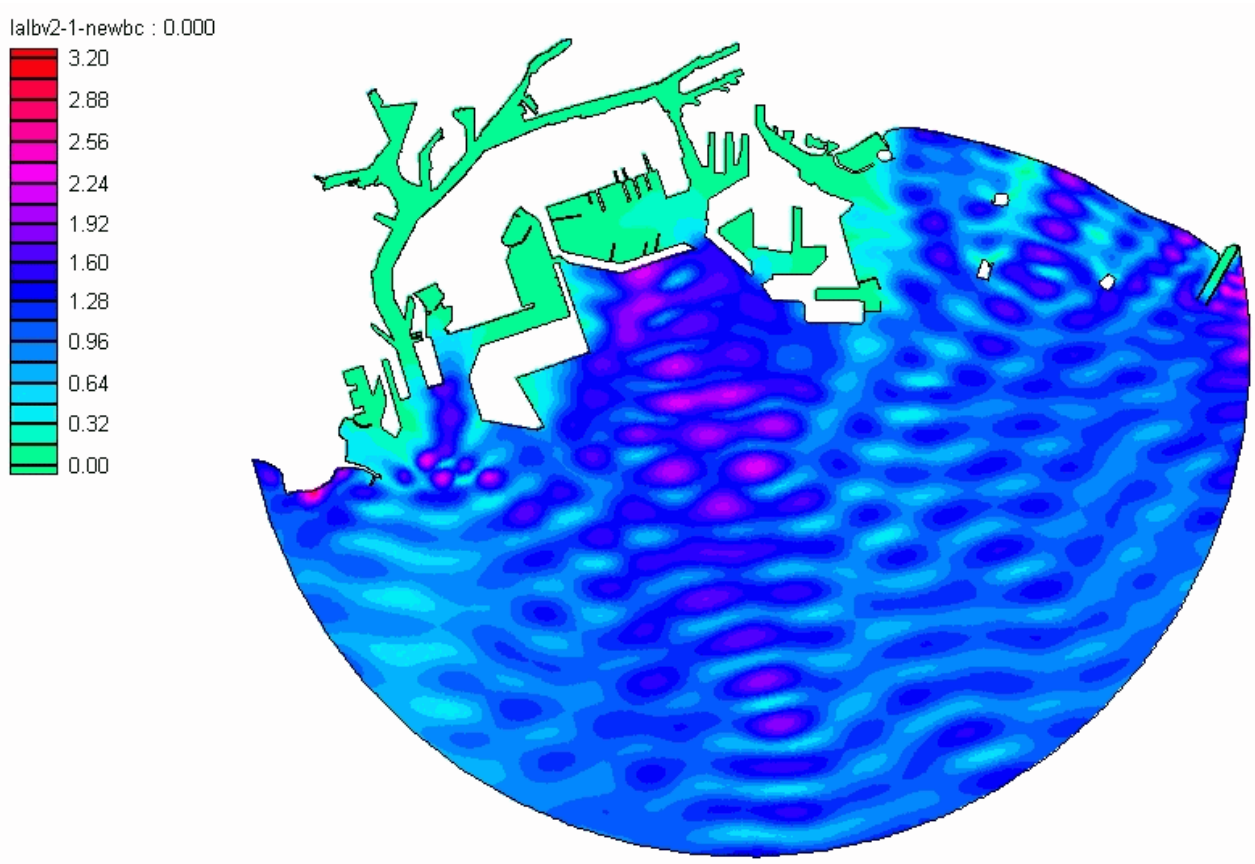
LALB with Breakwaters



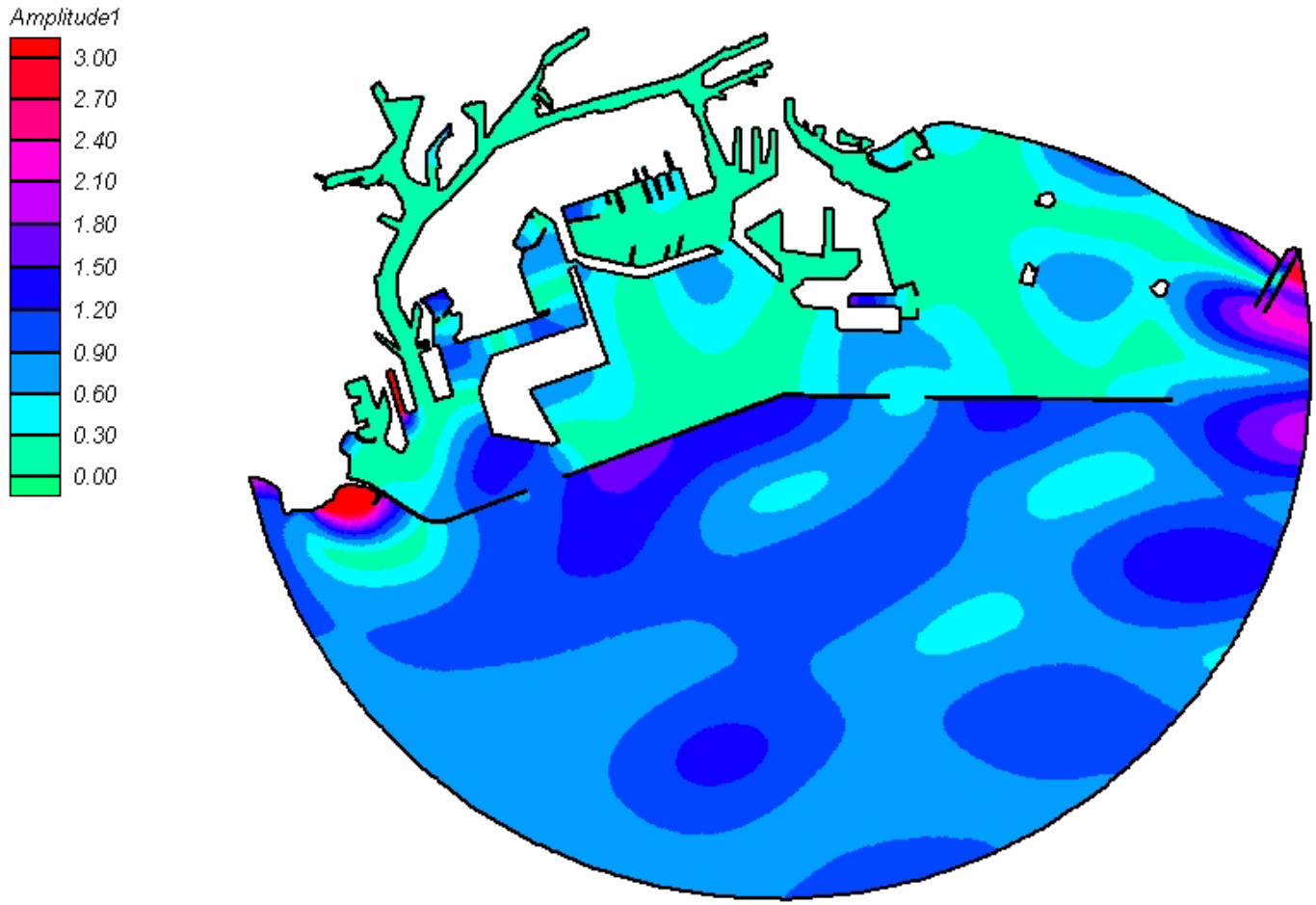
LALB without Breakwaters



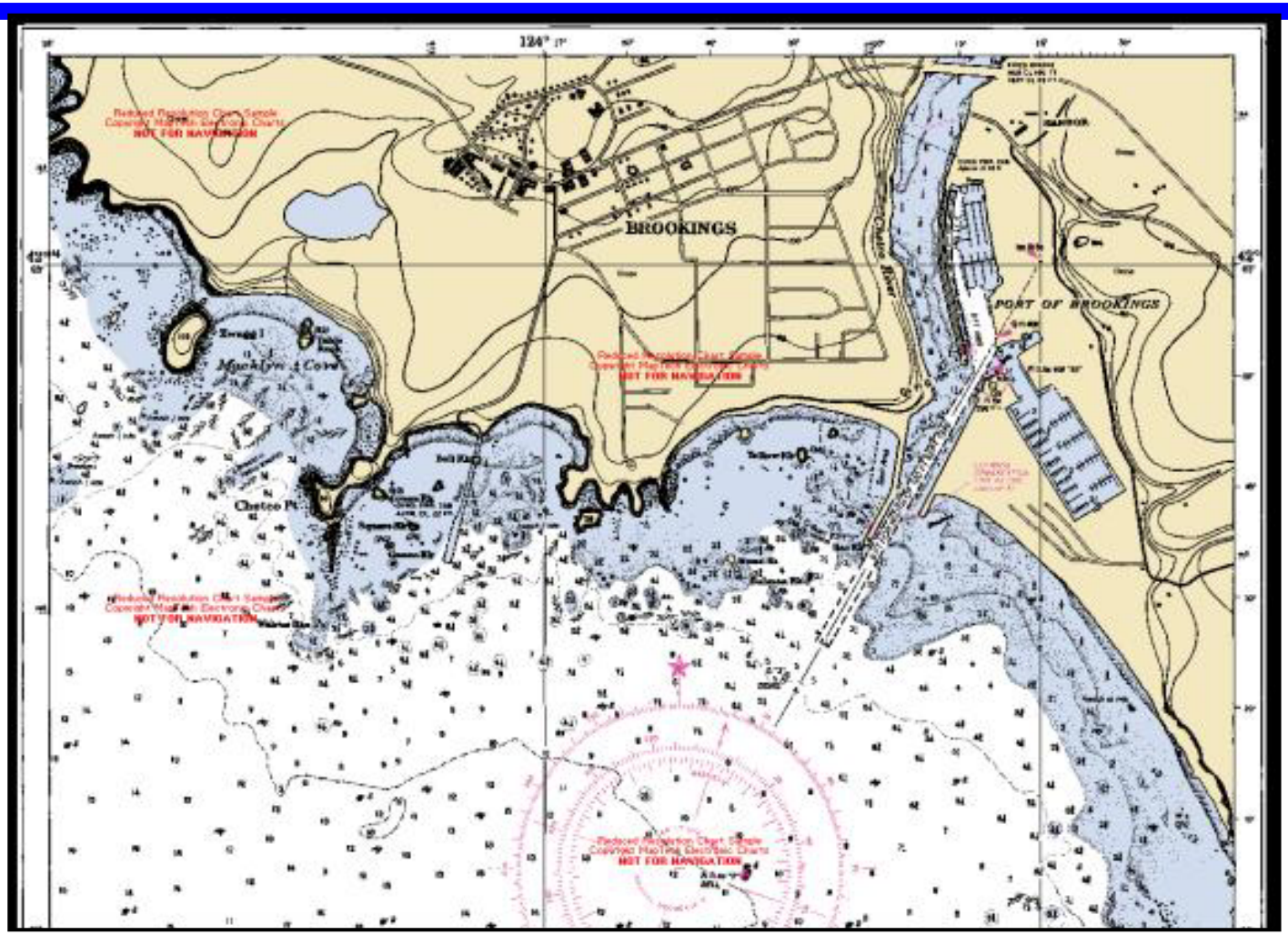
LALB – Amps w/out Breakwaters



LALB – Amps w/ Breakwaters



Brookings Harbor, OR



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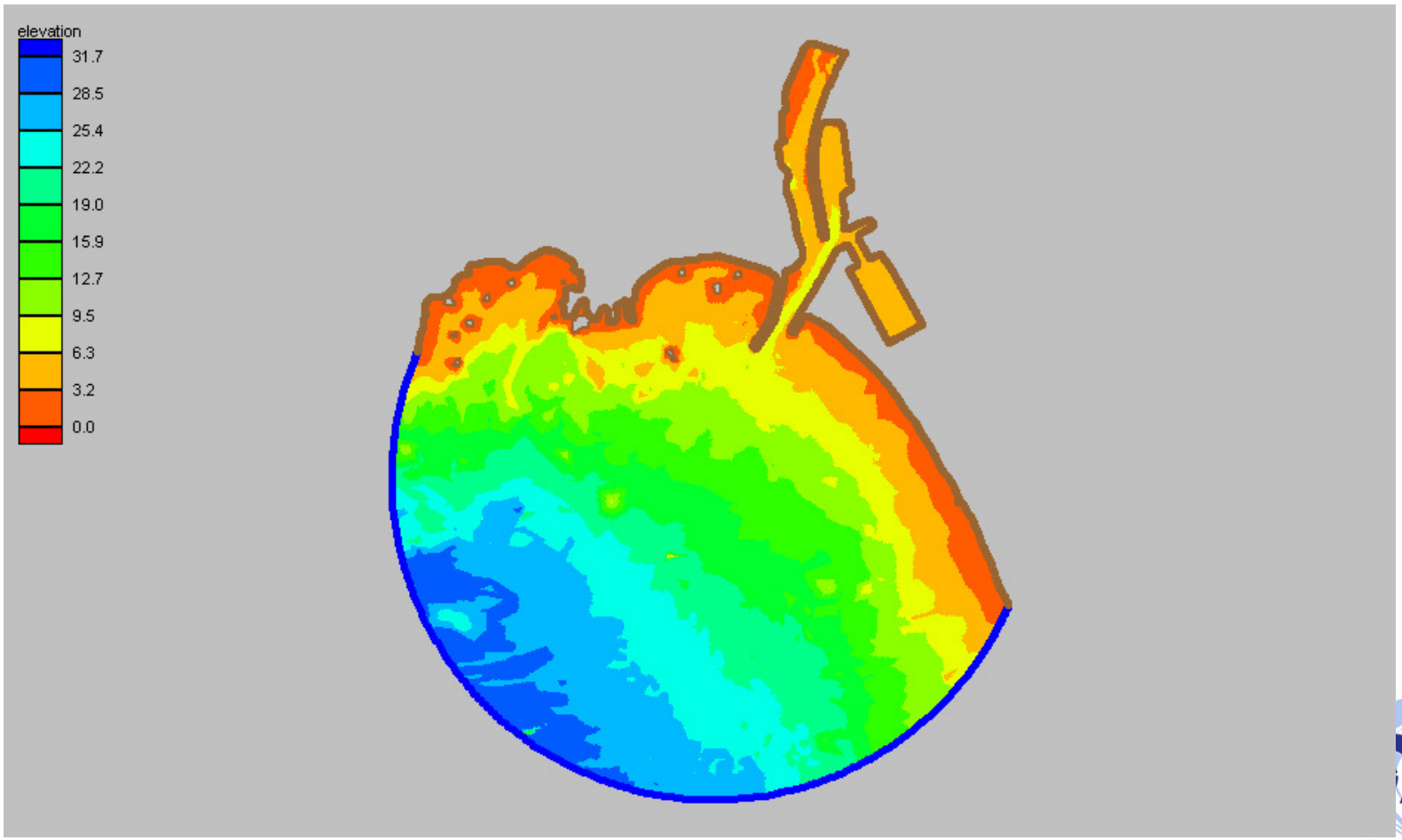

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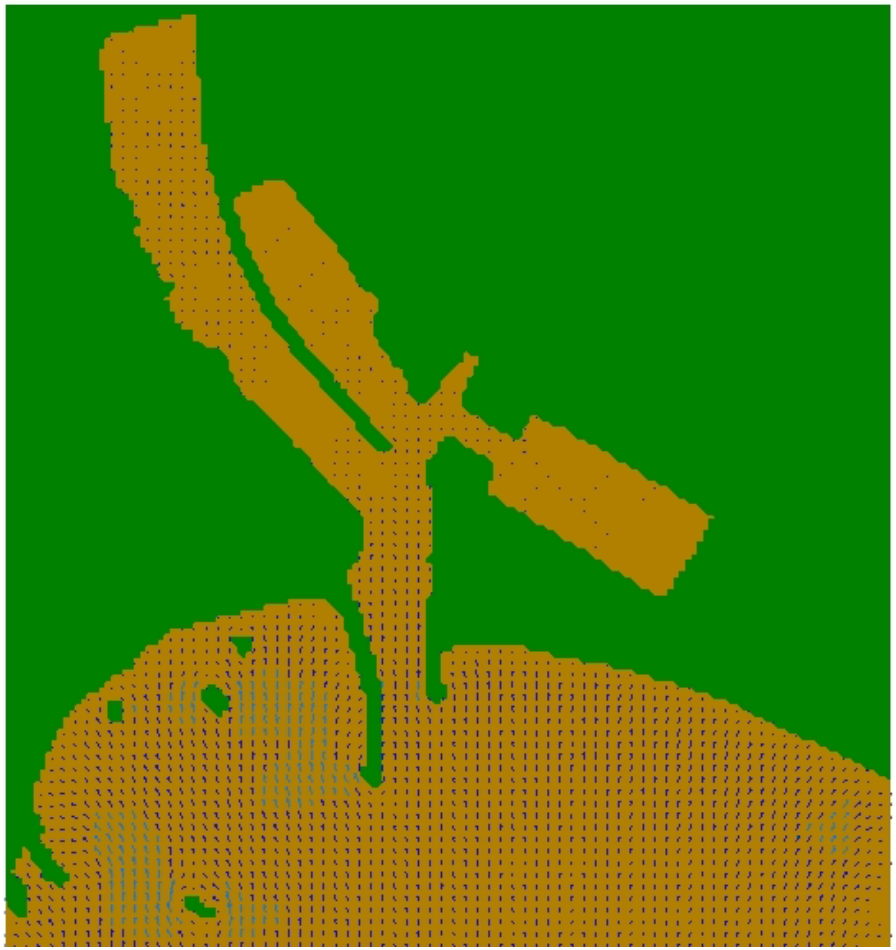

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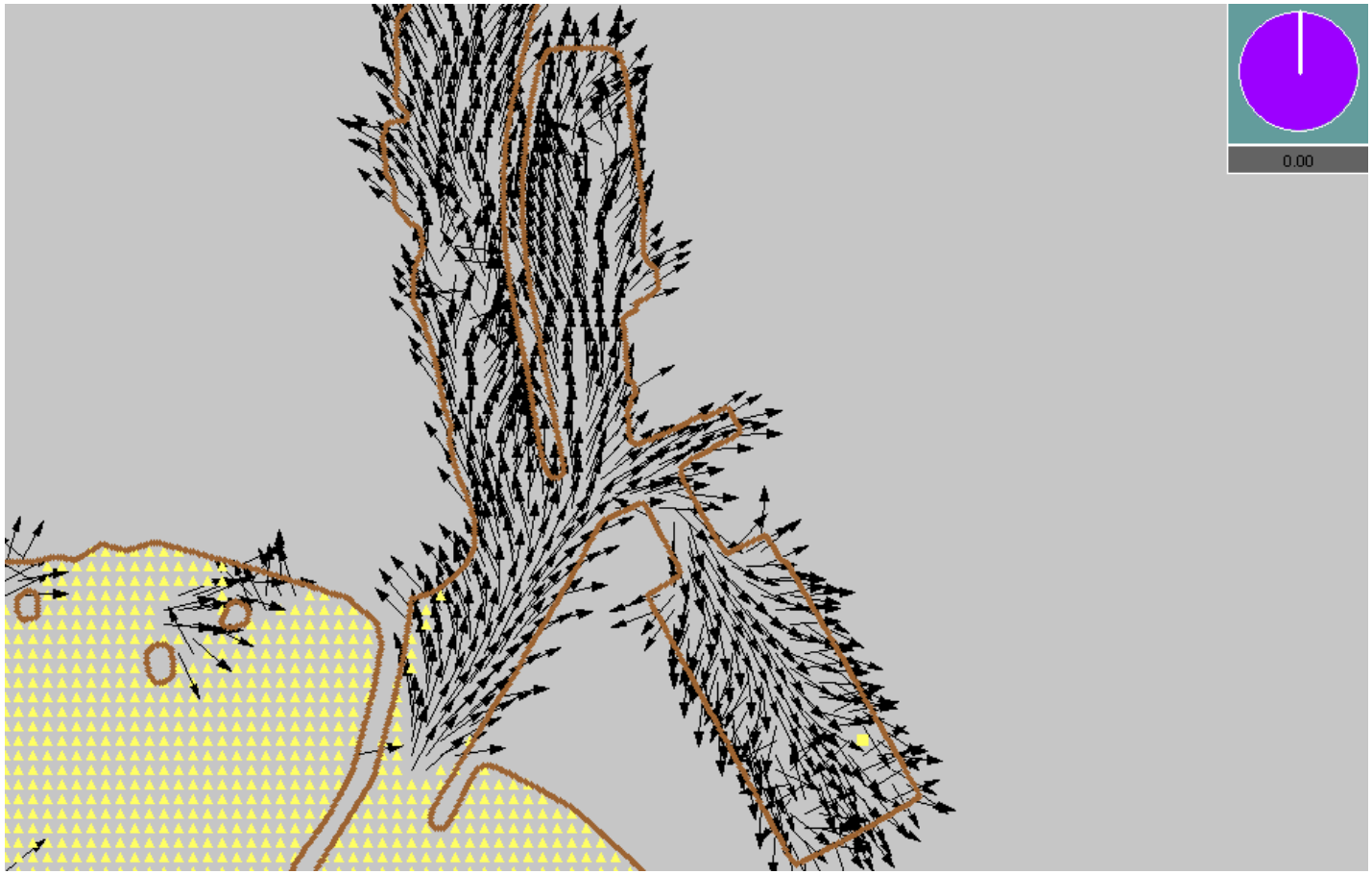
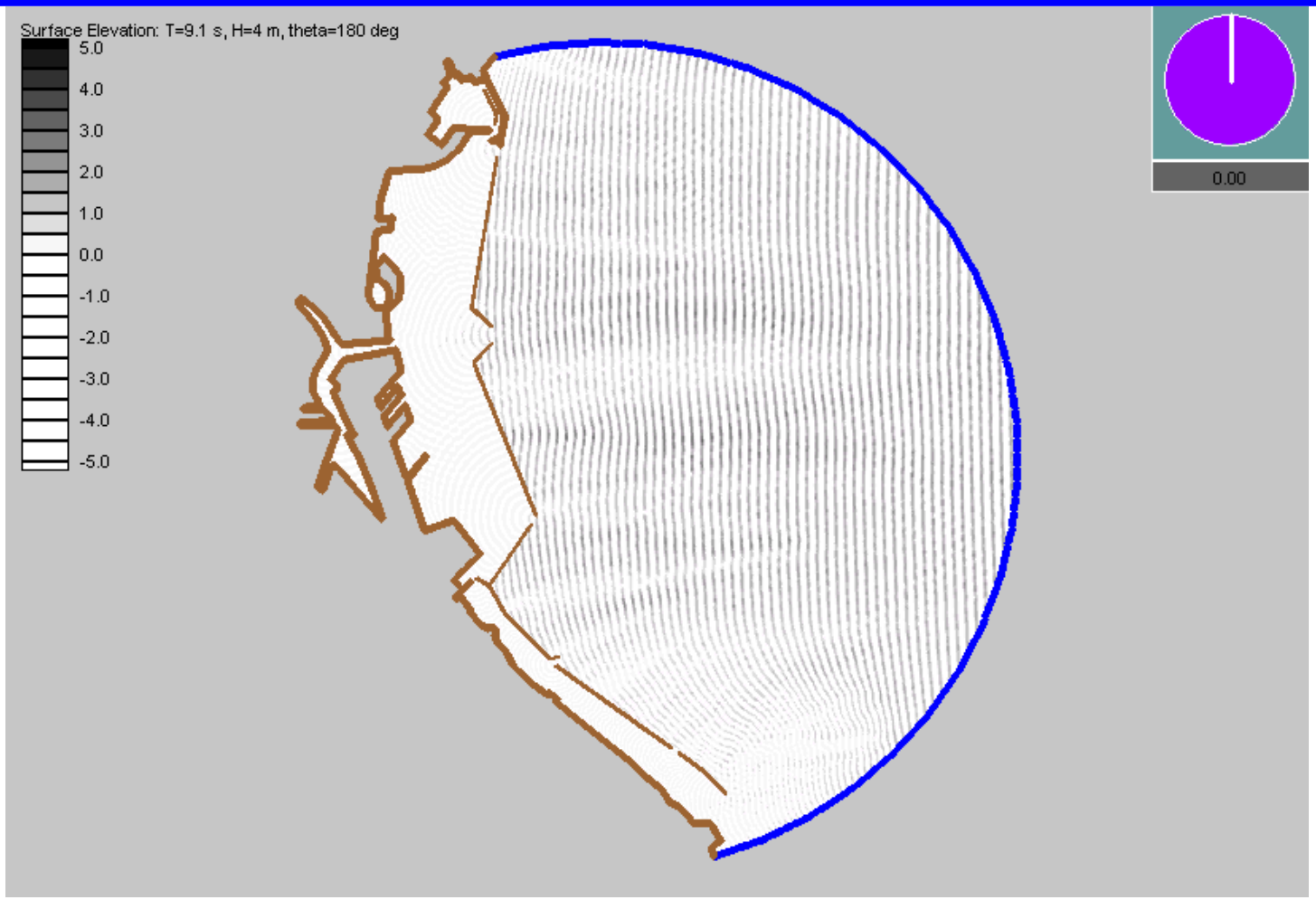


Milwaukee Harbor, WI



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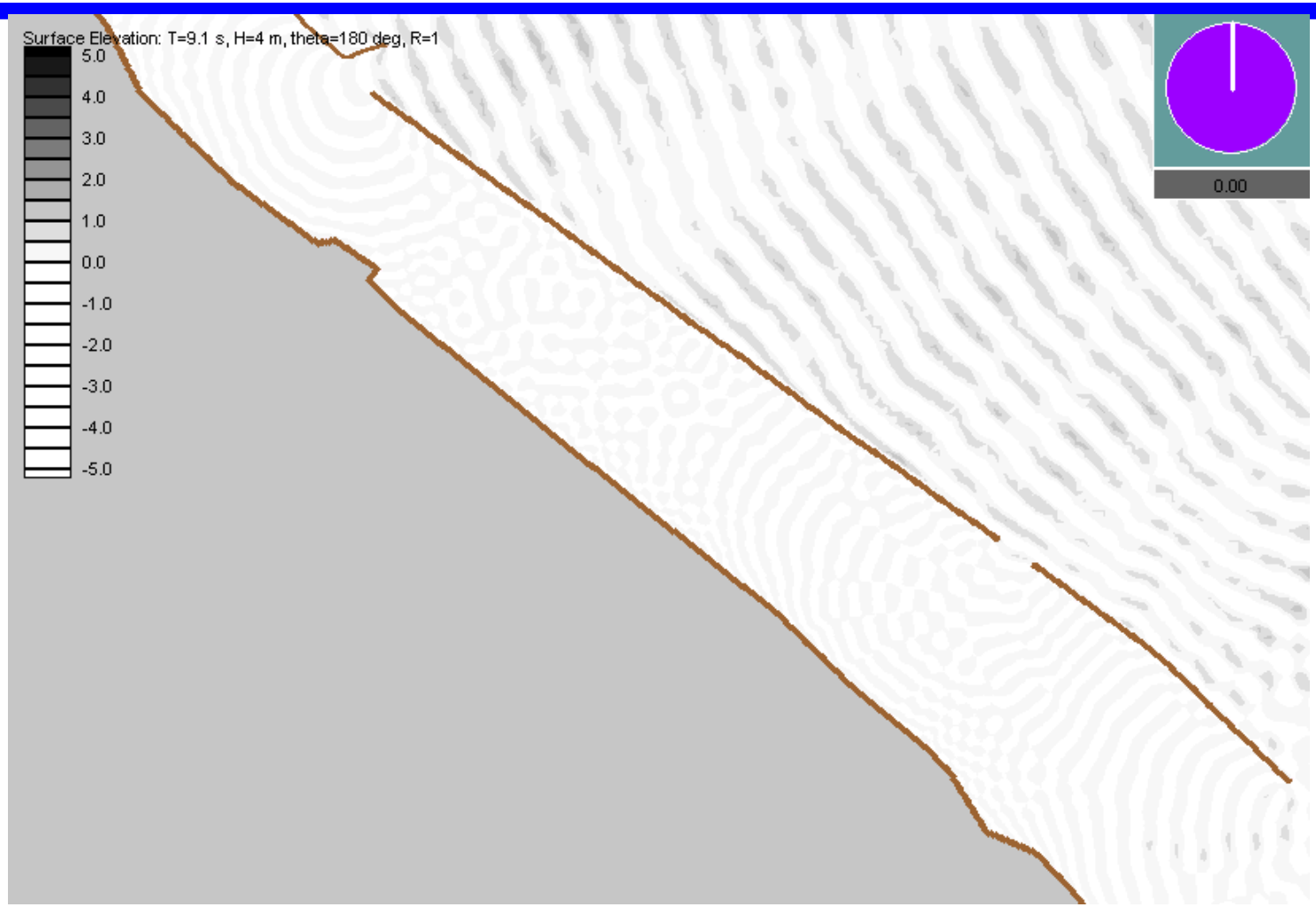
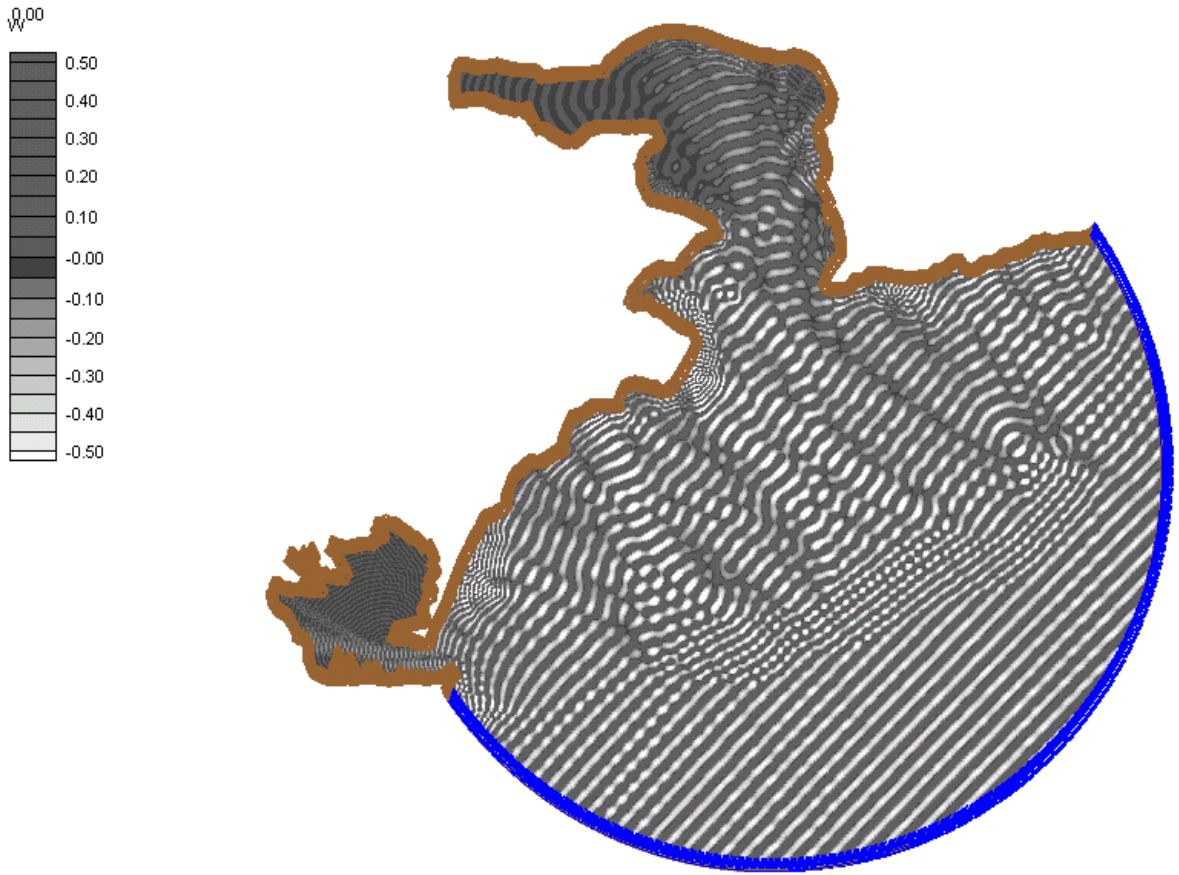
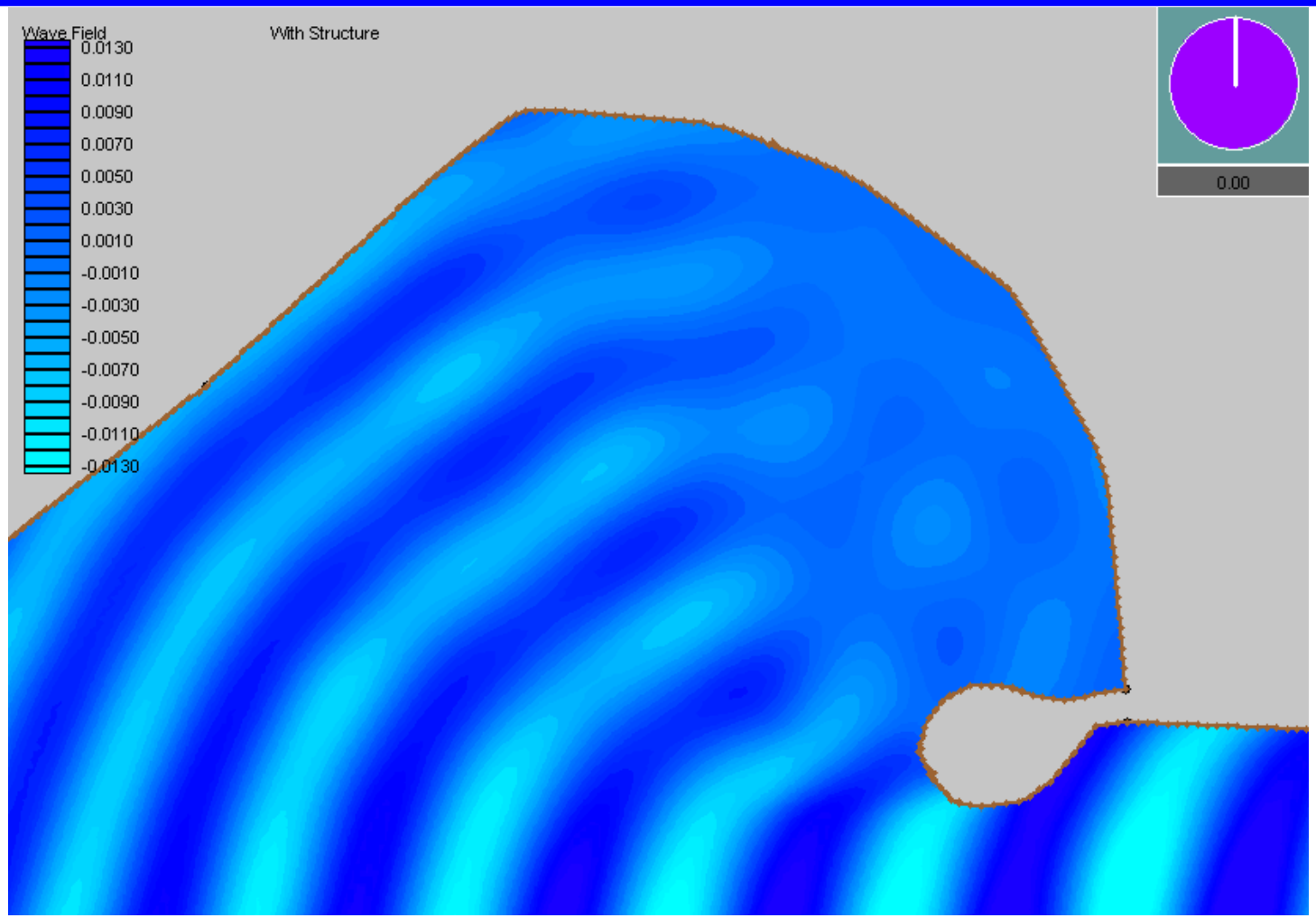


Tutuila Harbor, Samoa



Grays Harbor, South Jetty

South Jetty at Grays Harbor, WA



Kahului Harbor, HI

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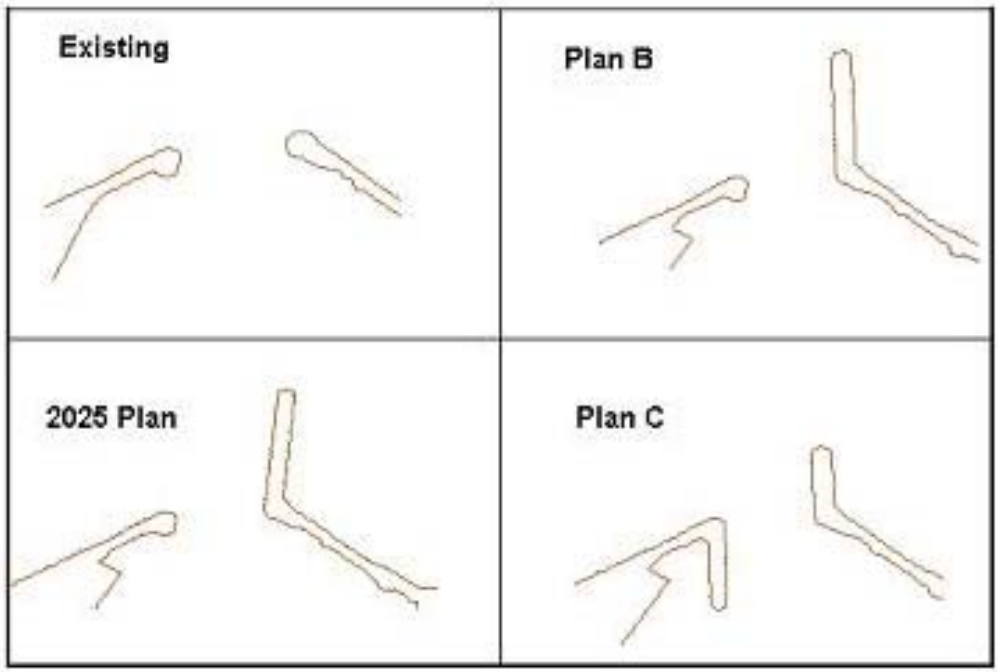

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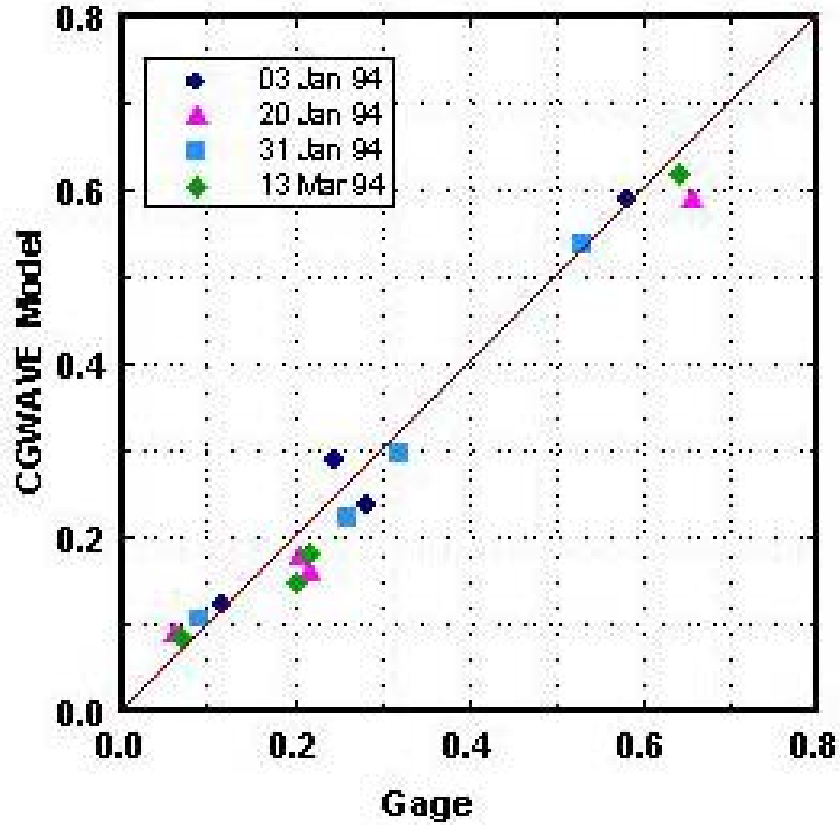
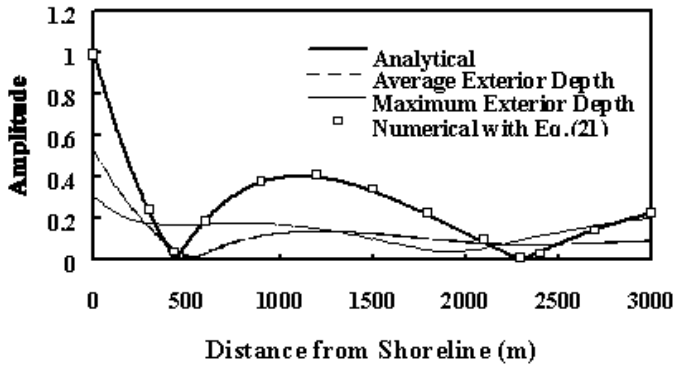
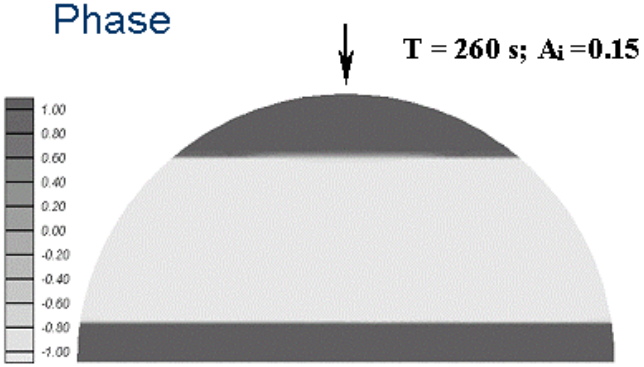


Sloping Beach – Long Waves

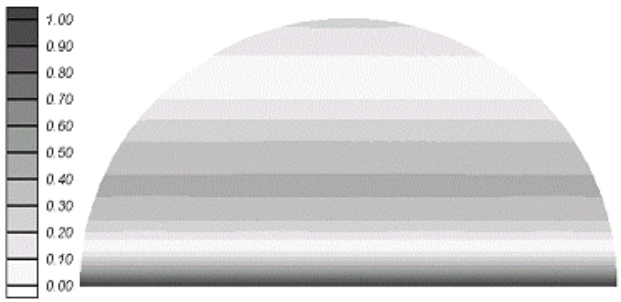


A=0.15m, T=260s, slope = 0.018
Depth cutoff at x=5m
R = 3000 m

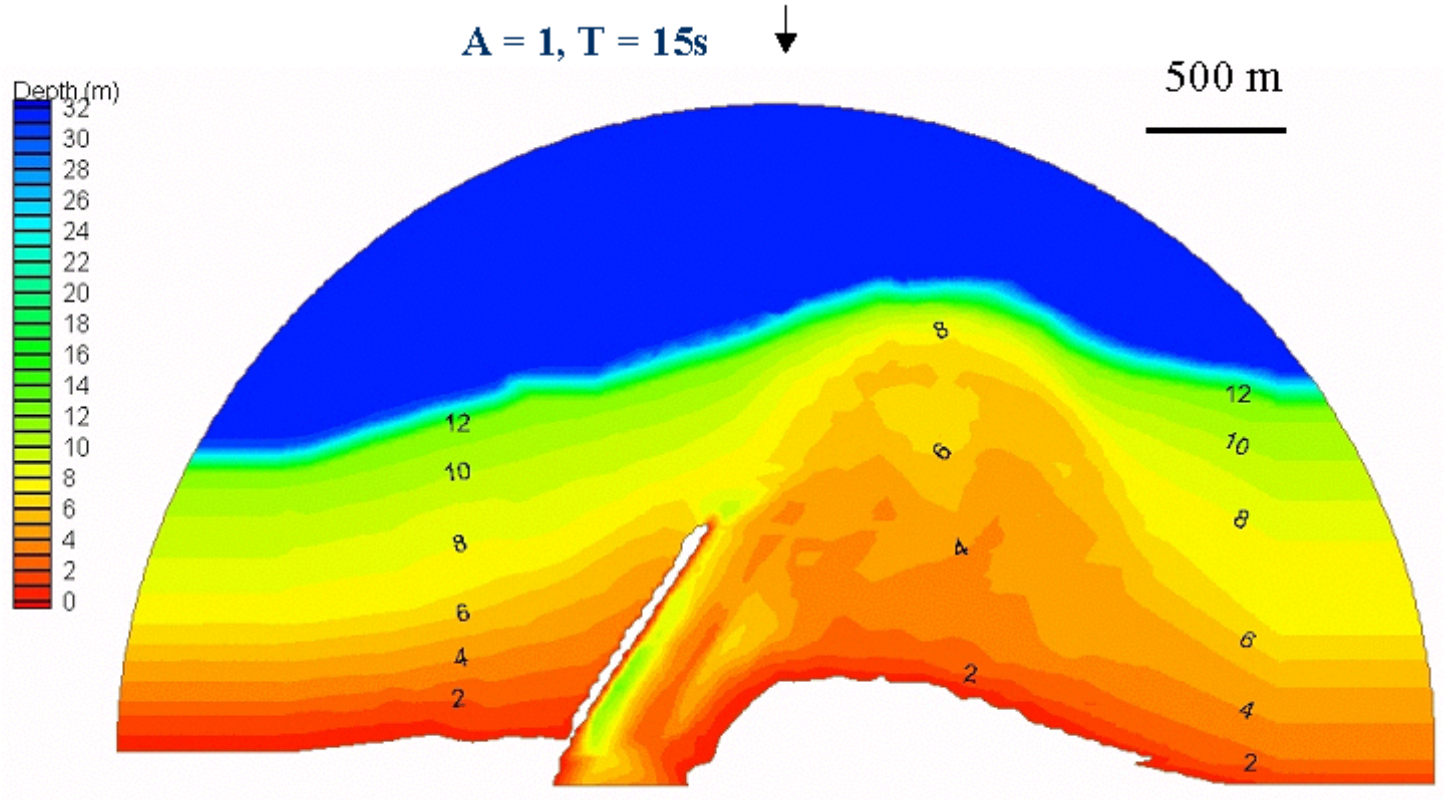
Phase



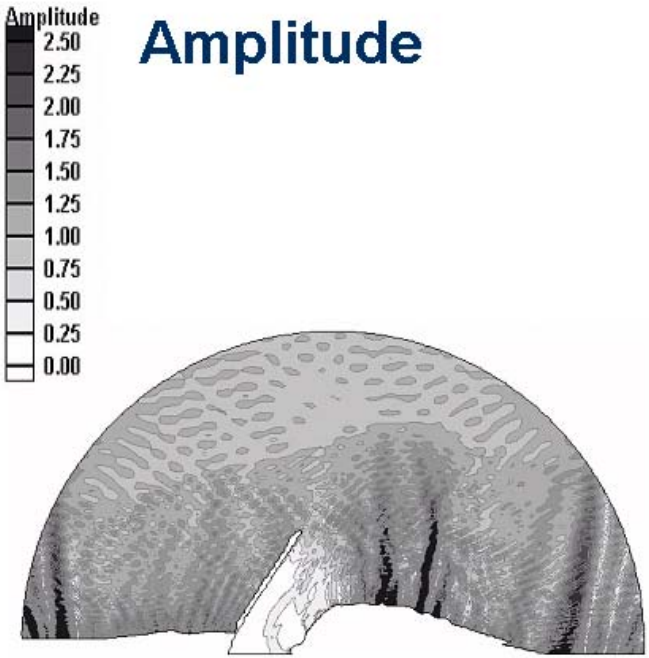
Amplitude

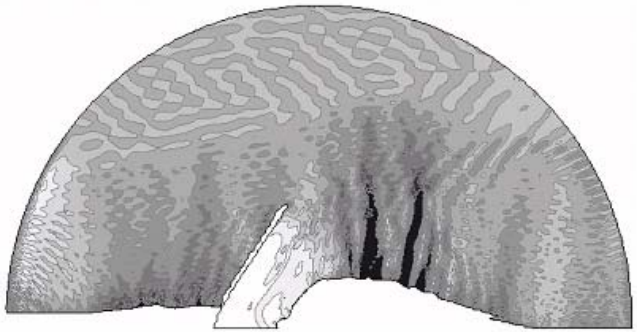


Ponce de Leon Inlet - Bathymetry



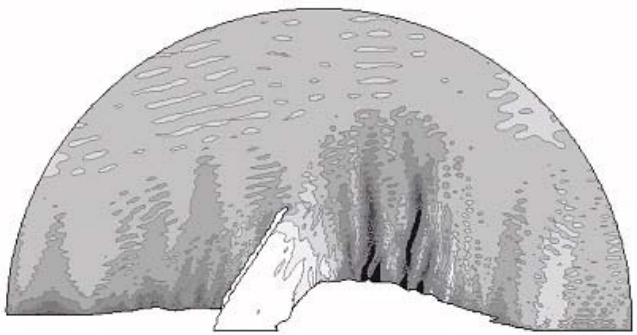
Ponce de Leon Inlet – Computed Amplitudes





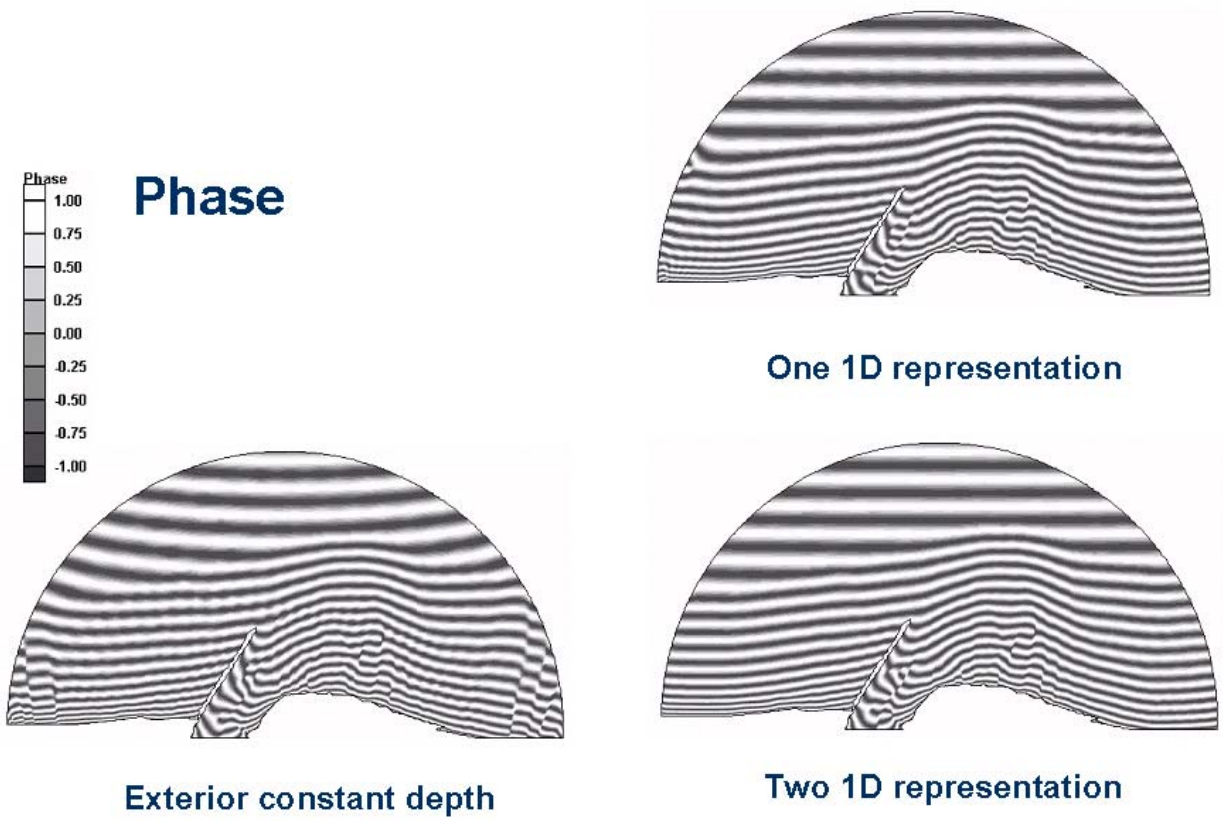
One 1D representation

Exterior constant depth

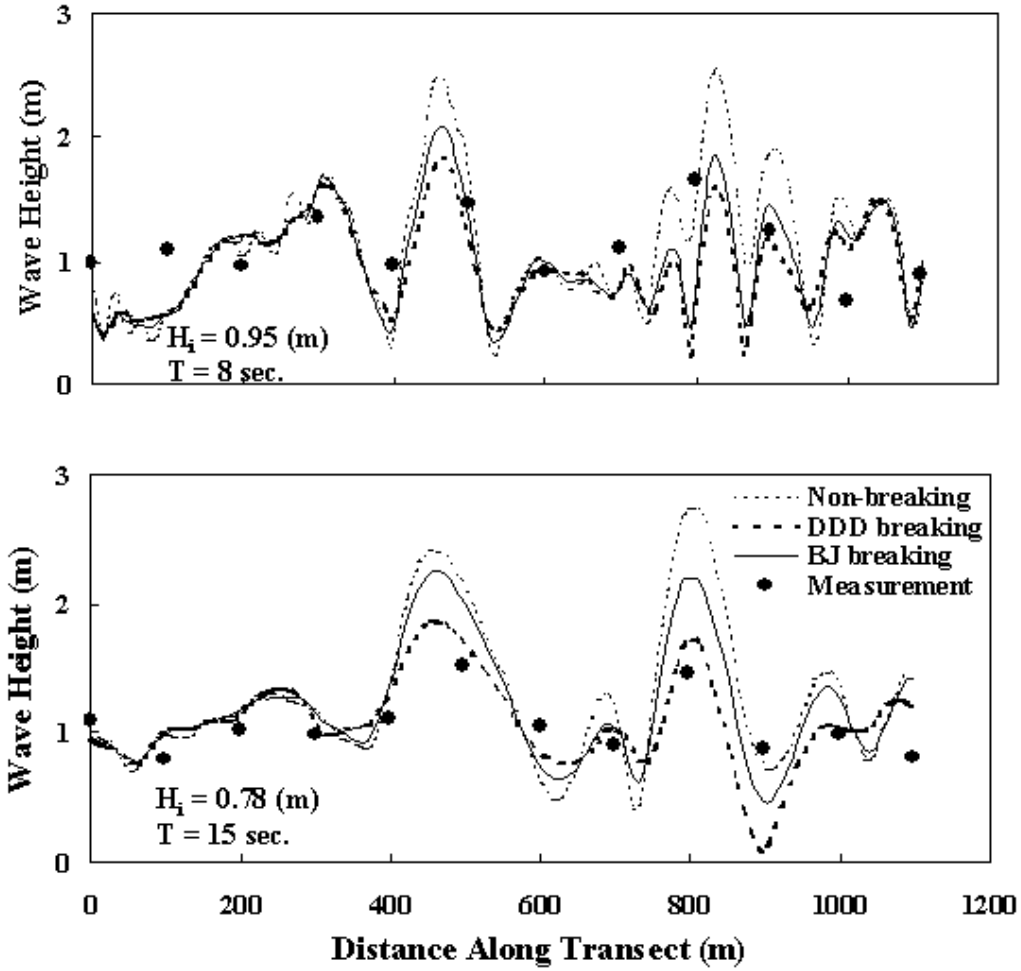


Two 1D representation

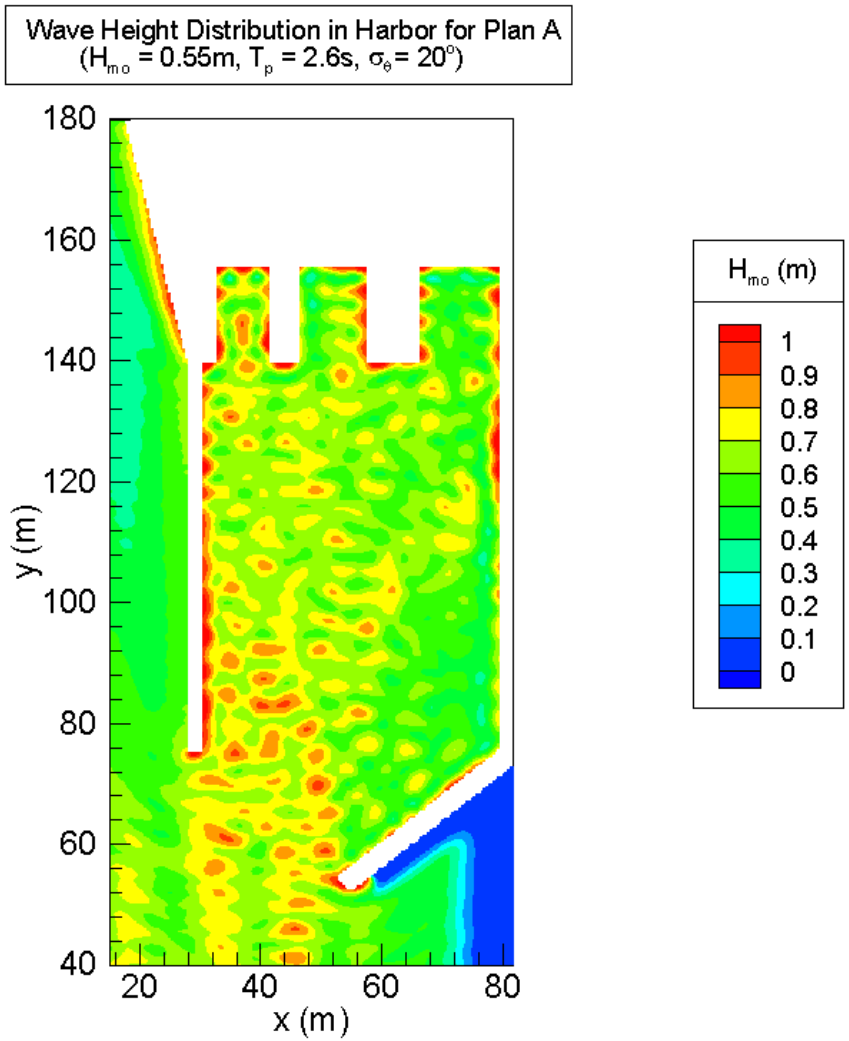
Ponce de Leon Inlet – Computed Phases

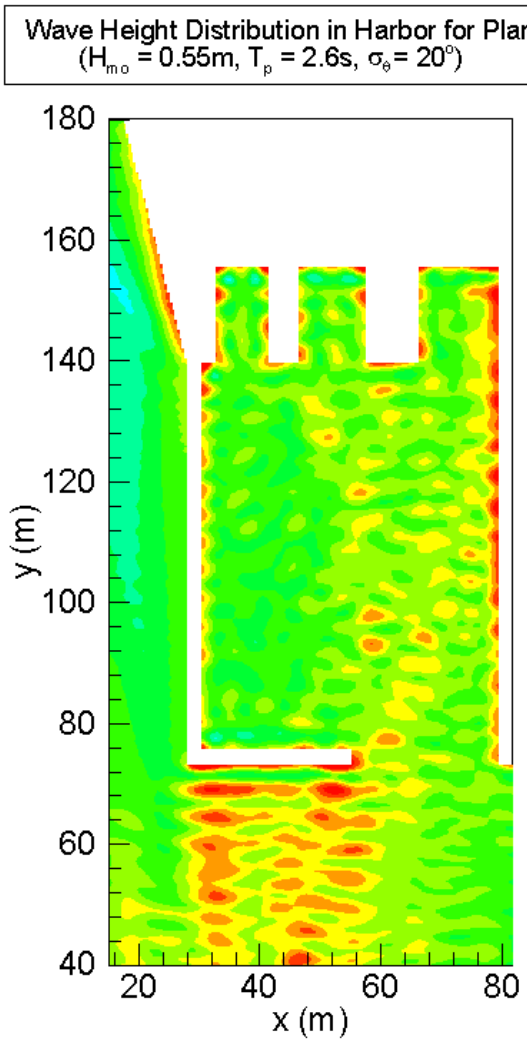


Ponce Inlet Wave Height

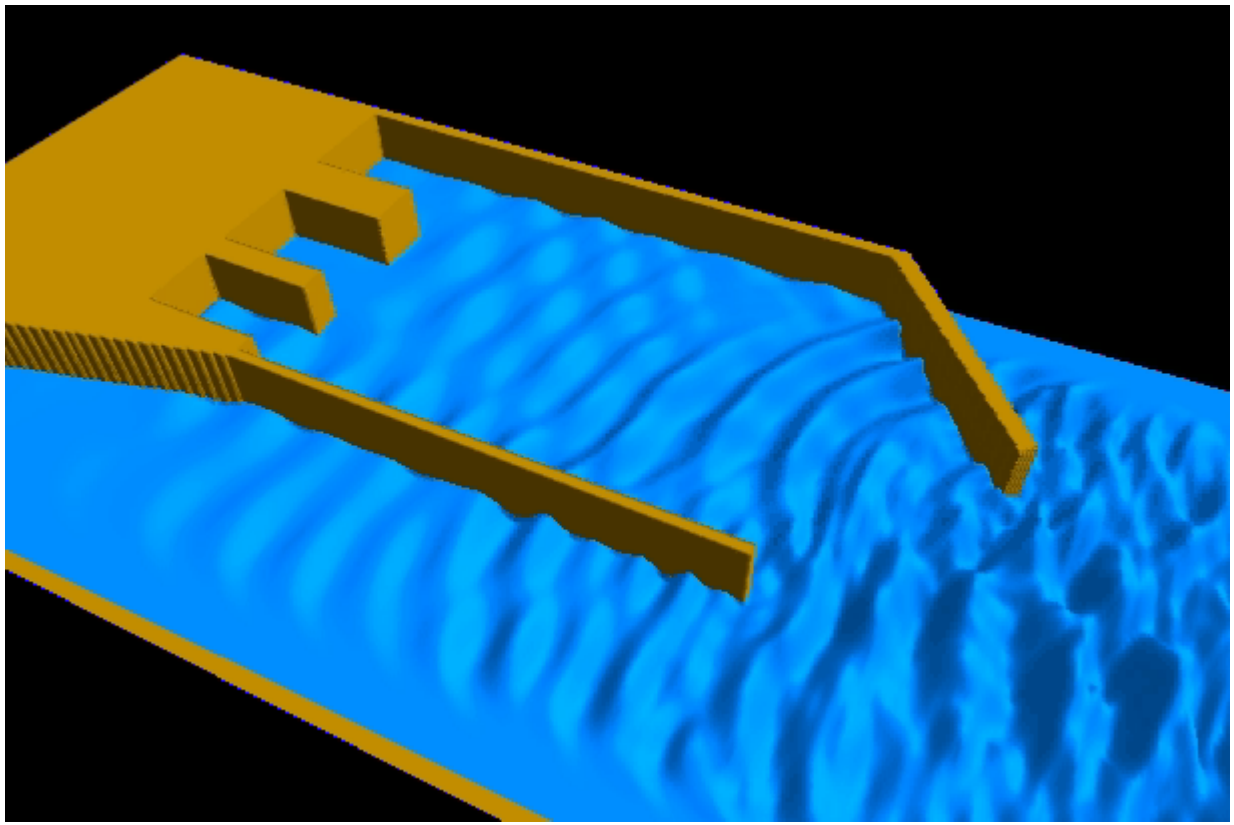


USCG Everglades Project

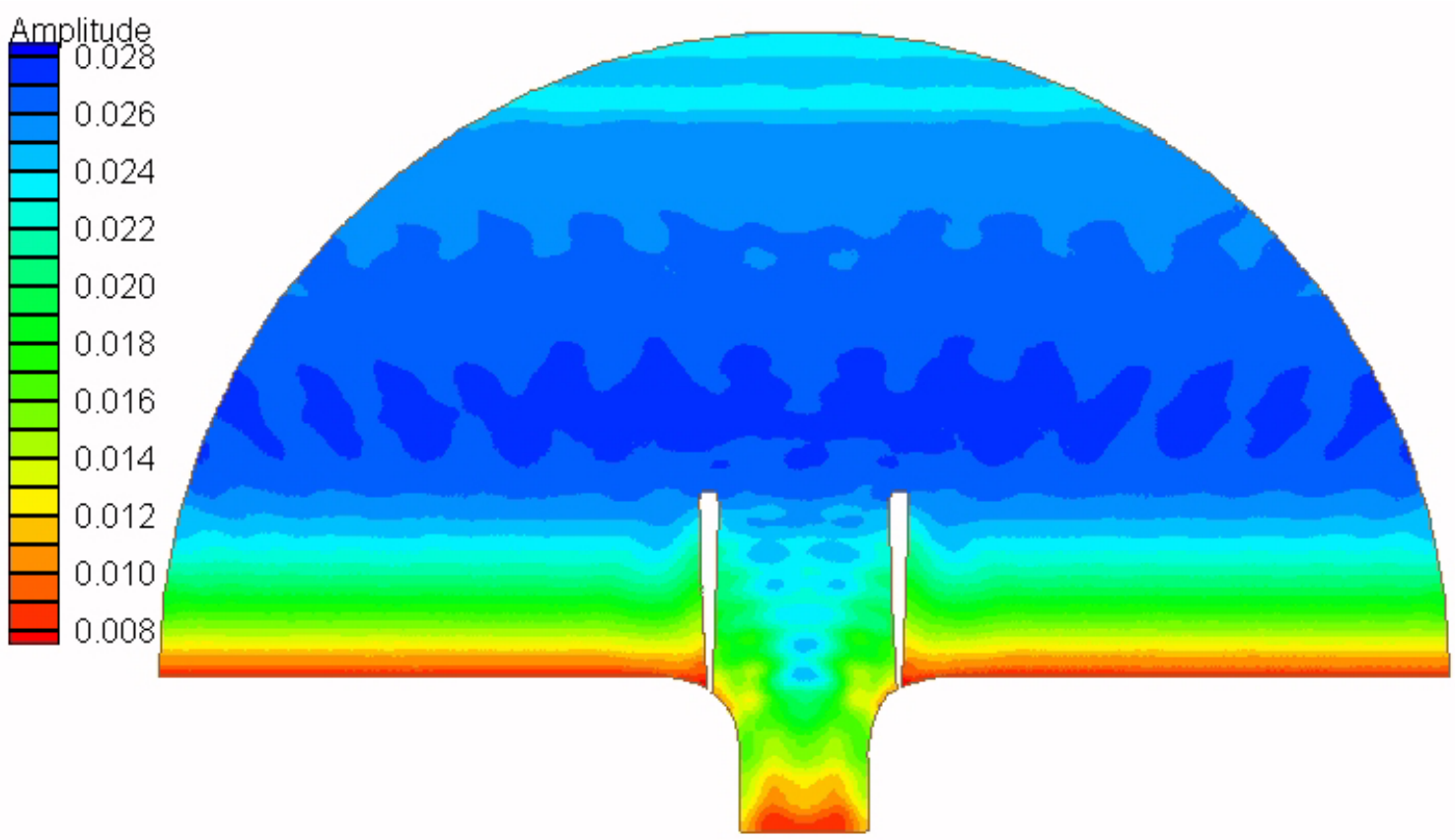




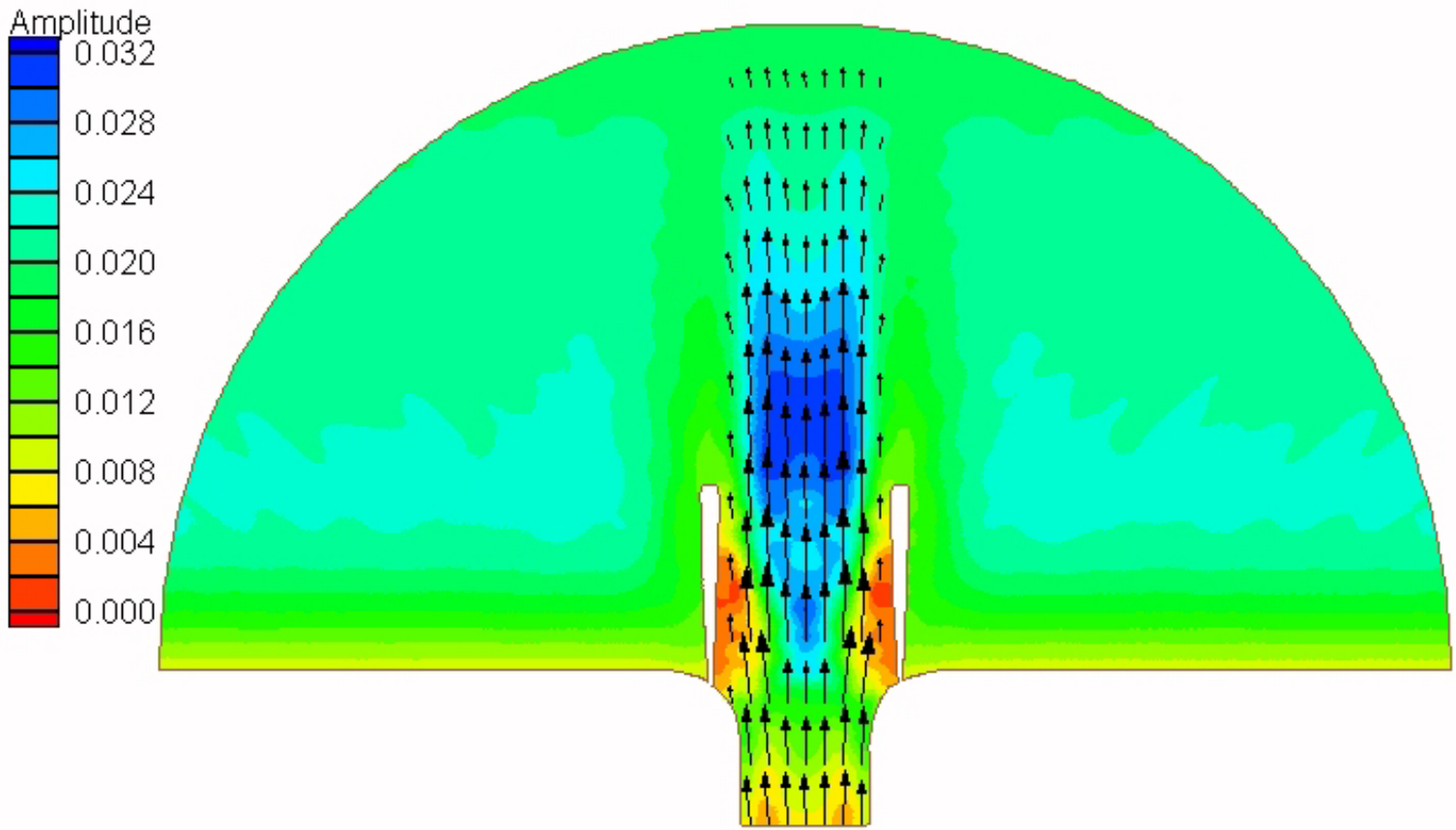
CGWAVE – Design Considerations



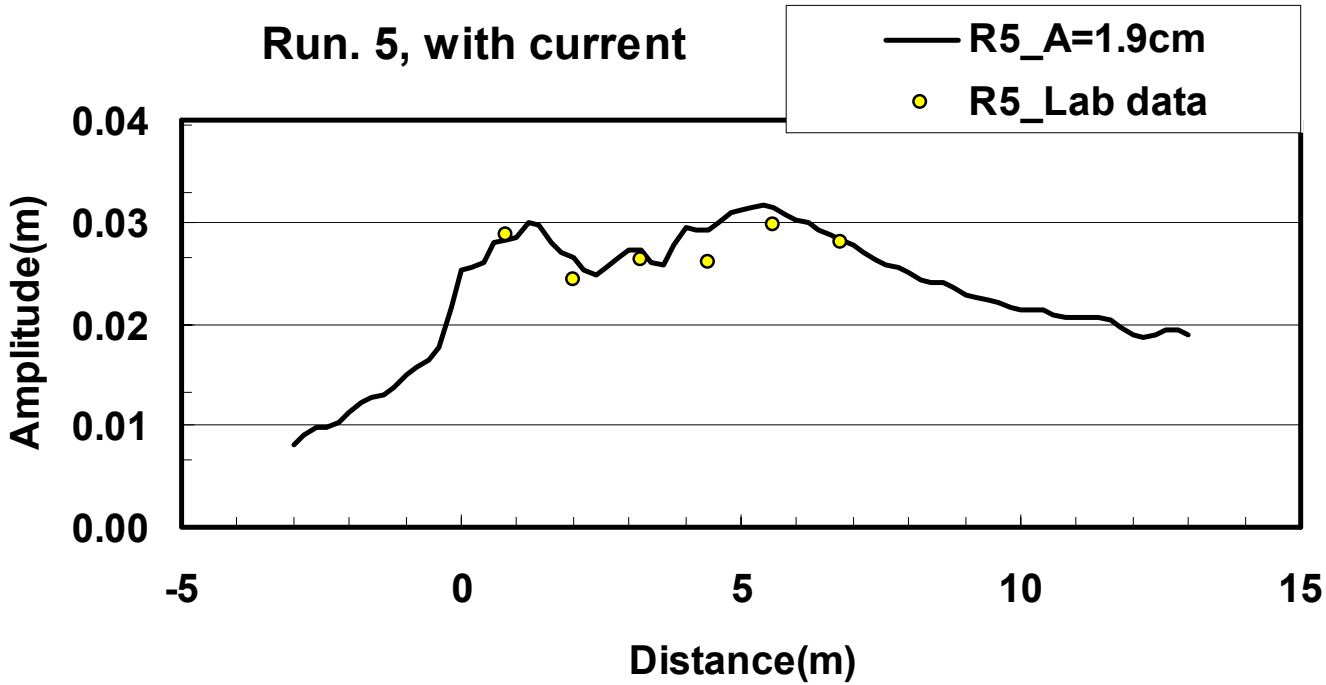
Wave-current Interaction



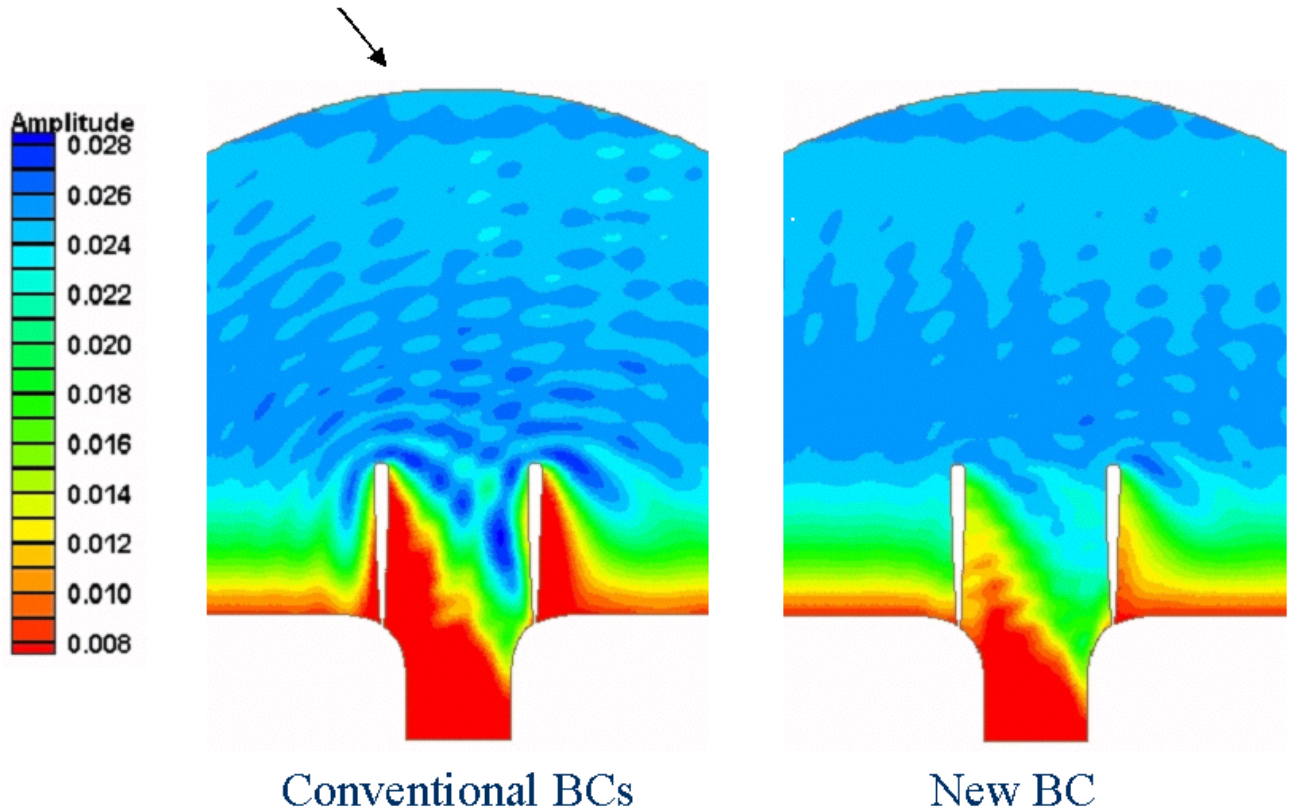
Wave-current Interaction



Wave-current Interaction



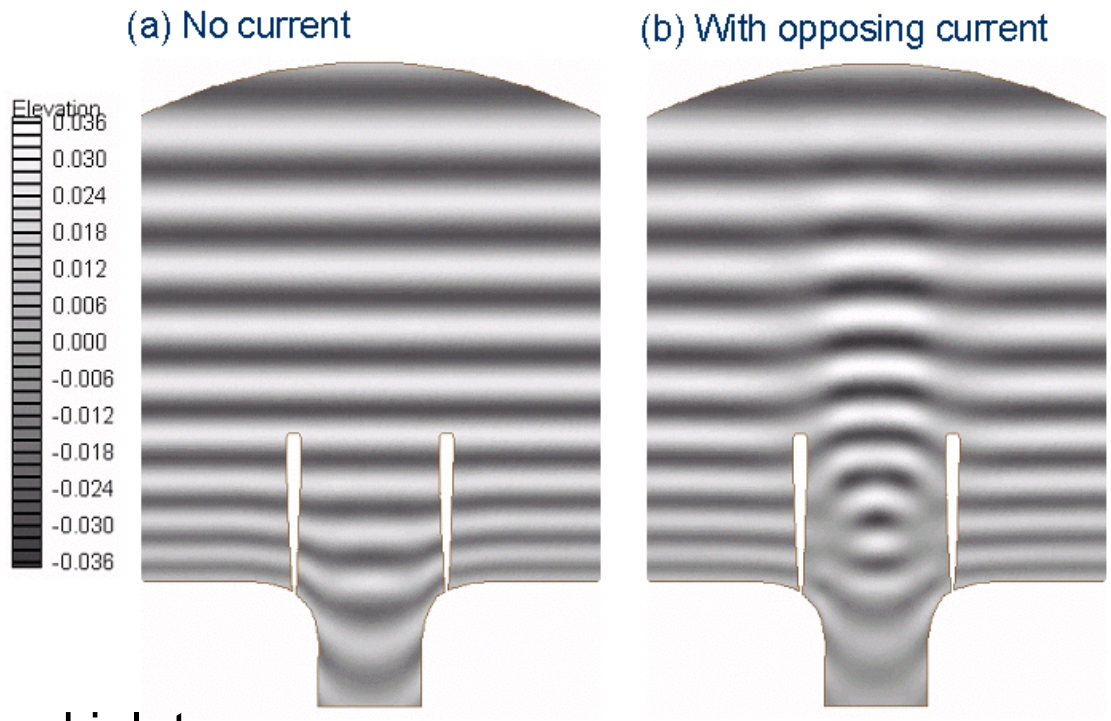
Oblique Incident Waves



- Idealized Inlet Case
  - A_i = .02 m
  - θ_i = 45°
  - K_T = 0.0

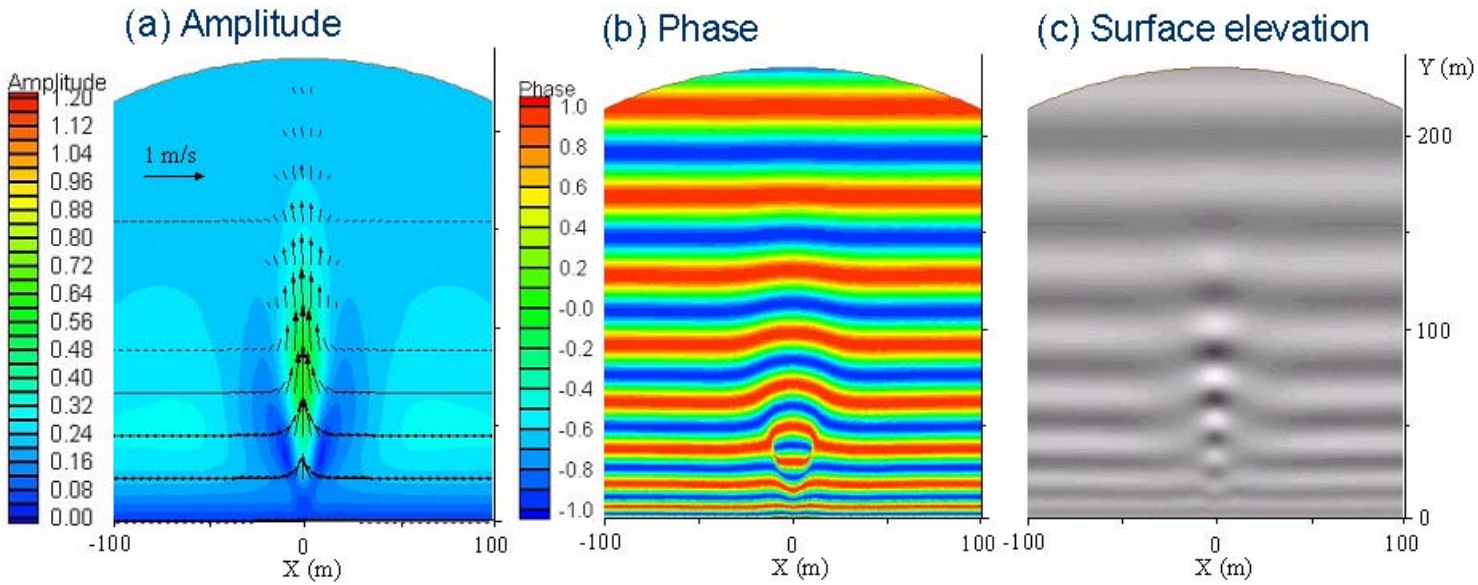
Interaction with Current

Jettied Inlet with Ebb Flow



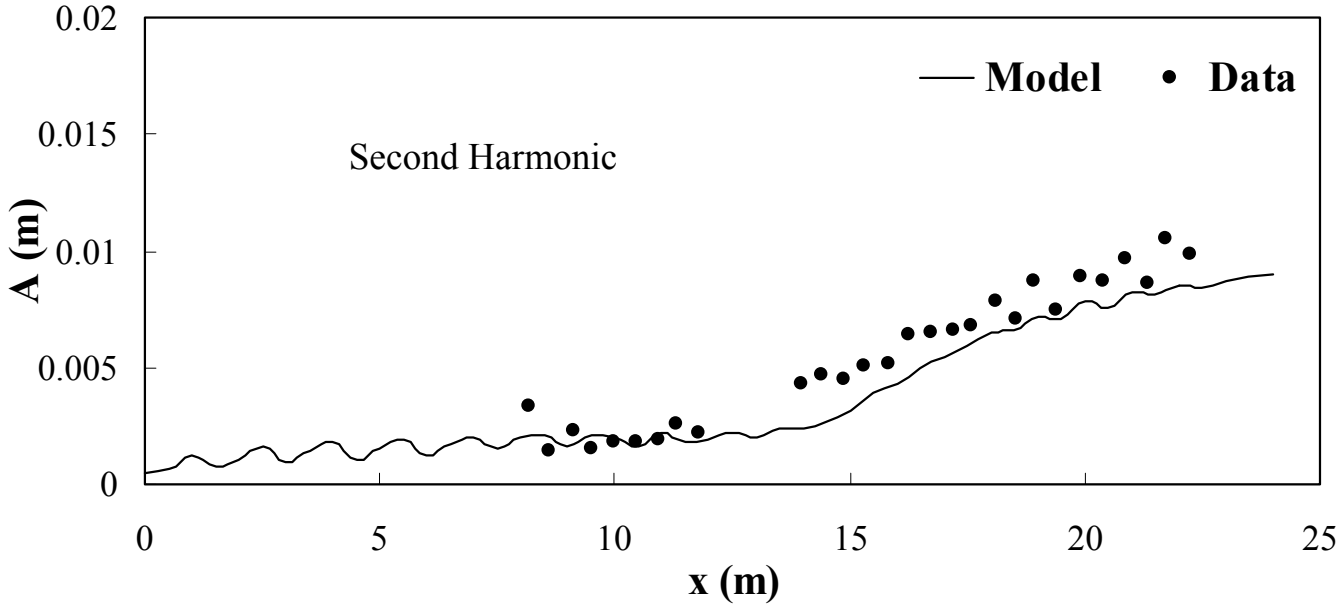
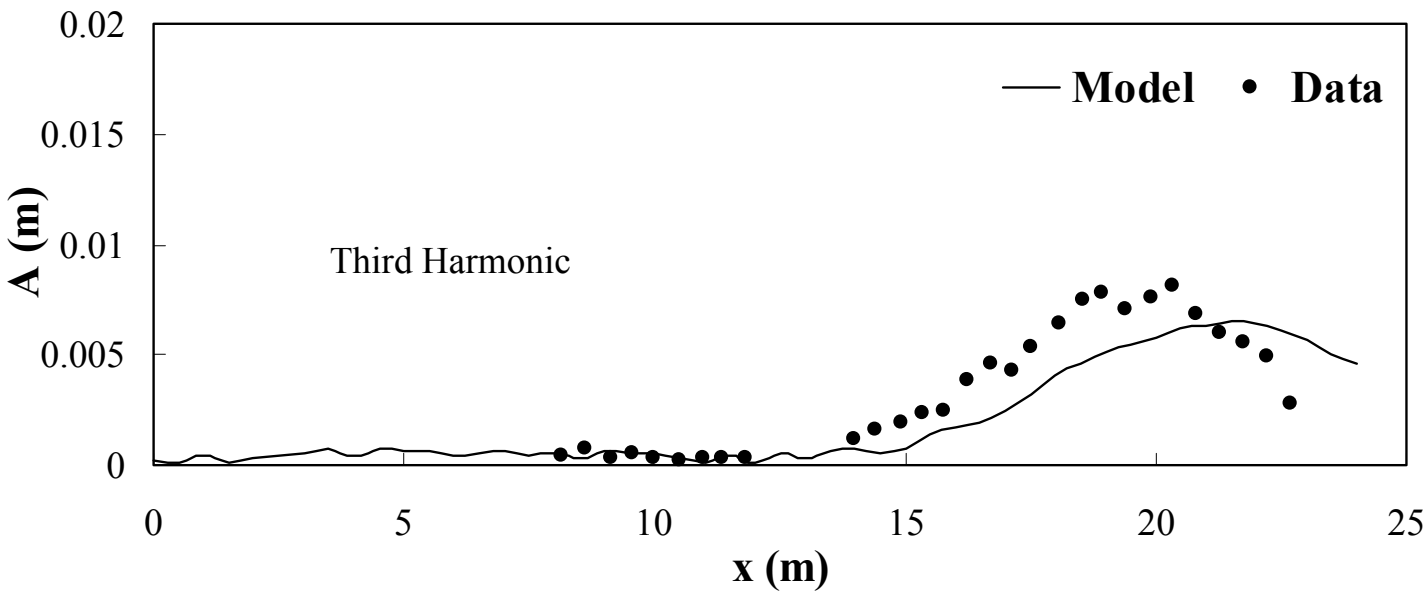
- Idealized inlet case
  - A_i = 2.5 cm
  - T = 1.4 s

Rip Current on a Sloping Beach



- Sloping Beach case – Includes breaking
  - A_i = .2 m
  - T = 8 s

Wave-wave Interaction



Wave-wave Interaction